

Detecting CP Violation in a Left-Right Symmetric World

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Kharzeev, Pisarski, and Tytgat¹ predict that CP odd states of matter will be formed in heavy ion collisions at RHIC. But their predictions do not require successive events to be all right handed or all left handed and, in fact, both scenarios are equally likely. This complicates the experimental observations.

The principle features of interest in the CP odd states are the residual E and B fields that interact with the quarks and gluons. The theory requires that the fields remain aligned but they may be parallel or anti-parallel, for different events, thus imparting a left handed or right handed helical motion to the quarks on an event by event basis.

We have studied this problem using the graphical analysis techniques presented earlier in this annual report². Figure 1A is a histogram for right-handed events which adds the pions from the π^+ peak and subtracts the pions from the π^- peak on a p_z vs p_y plot. The mean is non-zero indicating the strength of the CP violating signal.

Figure 1B shows our simulation of mixed events, 50% right and 50% left. The two peaks, one left and one right, are clearly defined. Note that while the histograms are summed over 5400 events, we have enhanced the simulated signal by a factor of 10 for these studies. Finally, figure 1C shows the L+R spectra after subtracting an event mixed background. This histogram would be flat if we couldn't identify the L+R states.

Thus, CP odd states are observable in a L+R mixed world but significantly more events will be required to make the observation than if we lived in an exclusively L or R world.

¹Kharzeev, Pisarski, and Tytgat, PRL **81**, 512 (1988).

²**Pattern Recognition in Parity and CP Violation Studies at RHIC**, J. Thomas and R. Longacre, these proceedings.

Figure 1: 1A: A pure right-handed world yields a clear signal. 1B: A mixed, L+R, world can be identified by the broadening of the peak. 1C: The signal is quantitatively identified by subtracting a random, event mixed, background.

